PMP15005 Test Results

Test Data

PMP15005

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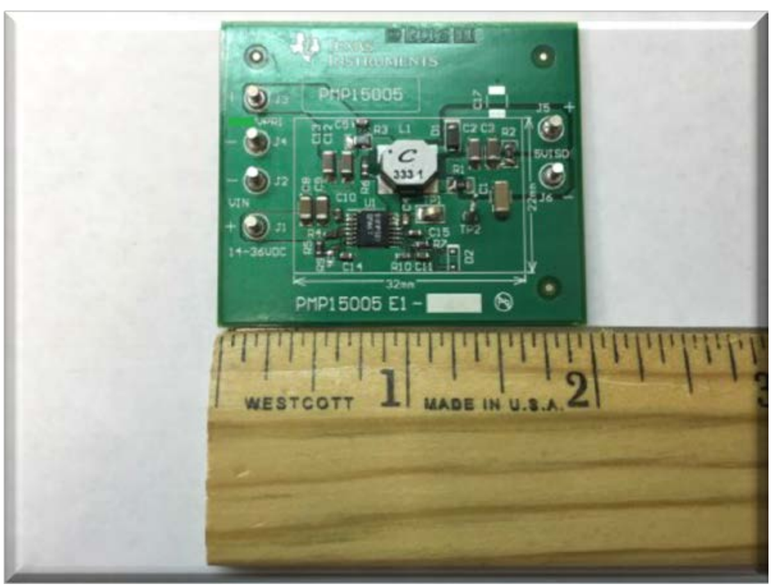
Circuit Description

PMP15005 uses the LM5160 in a Fly-Buck topology with the primary and secondary output both set to 5V nominal. The circuit accommodates a voltage input range from 14V to 36V, ideal for the 24-V nominal input rail. While the primary side is set at 5.4V nominally, using the feedback resistors, the secondary isolated side sees 5V, based on Coilcraft's LPD8035V series coupled inductor set at a turns-ratio of 1:1. The maximum operating current on both the primary and secondary rails are set at 225mA each. The switching frequency is set at 300 kHz nominal.

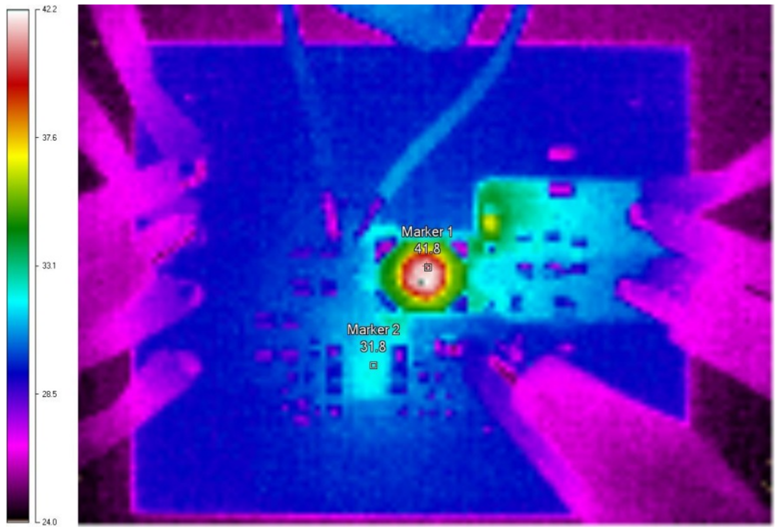
Power Specification

VIN Min.	**14-V**
VIN Max.	**36-V**
$V_{OUT,PRI}$	**5-V (±1%)**
$V_{OUT,SEC}$	**5-V (±10%)**
$I_{OUT,PRI}$	**0-A-0.225-A**
$I_{OUT,SEC}$	**0-A-0.225-A**
Approximate Switching Frequency	**≈300 KHz**

Board Photo (with LM5160)

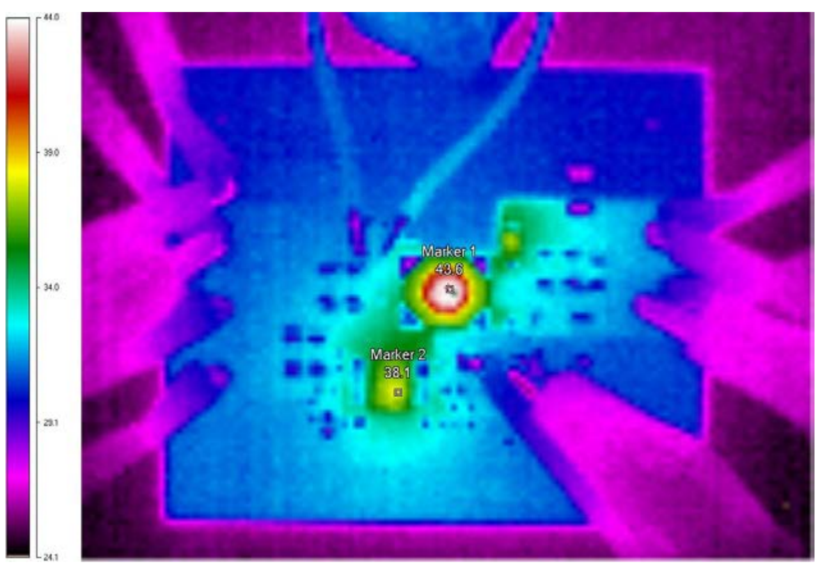


Thermal Image of the EVM at 14VIN &I_{PRI}=I_{SEC}=0.225A



The Marker 1 in the picture above represents the surface of the coupled inductor and the Marker 2 represents the IC. As seen in the picture the coupled inductor is the hottest part on the board during the operation.

Thermal Image of the EVM at 36VIN &I_{PRI}=I_{SEC}=0.225A



The Marker 1 in the picture above represents the surface of the coupled inductor and the Marker 2 represents the IC. As seen in the picture the coupled inductor is the hottest component on the board during the operation.

Efficiency Data

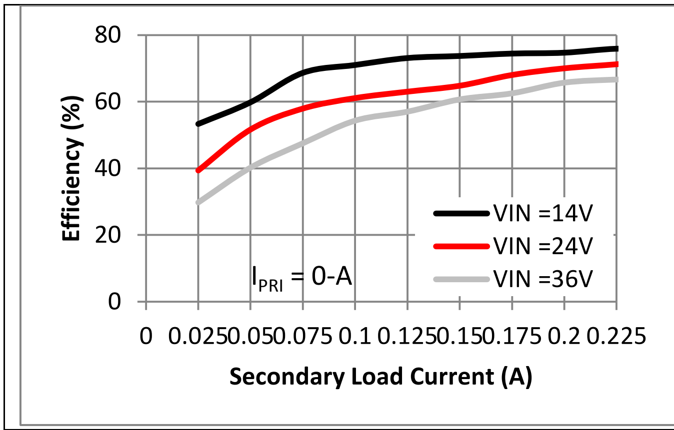


Figure 1. Efficiency with I_{PRI} set at 0A load and I_{SEC} increasing from 0.025A to 225mA

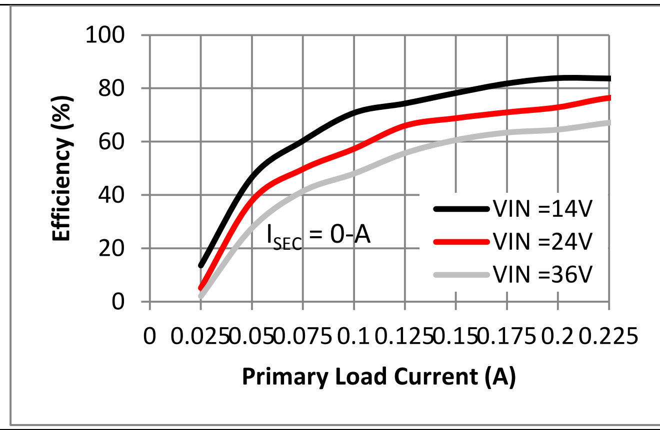


Figure 2. Efficiency with I_{SEC} set at 0A load and I_{PRI} increasing from 0.025A to 225mA

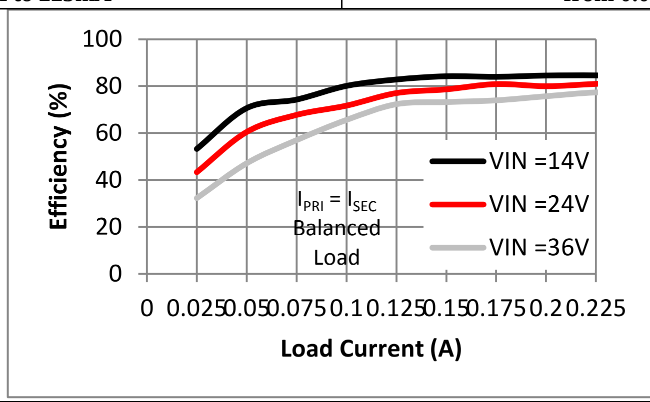


Figure 3. Efficiency with I_{PRI} = I_{SEC} = Load Current increased from 0.025A to 0.225A on each rail

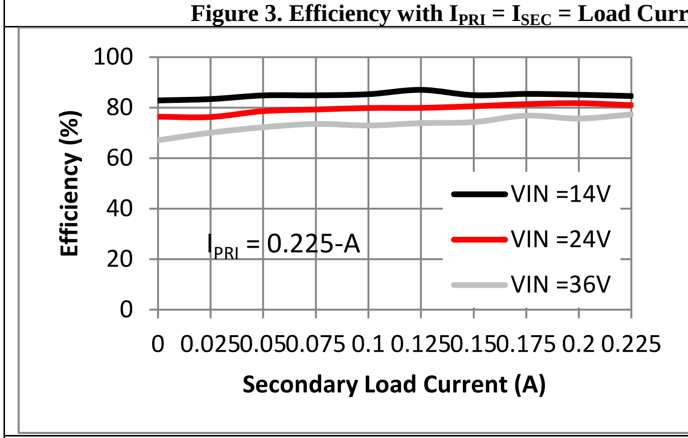


Figure 4. Efficiency with I_{PRI} set at 225mA load and I_{SEC} increasing from 0A to 225mA

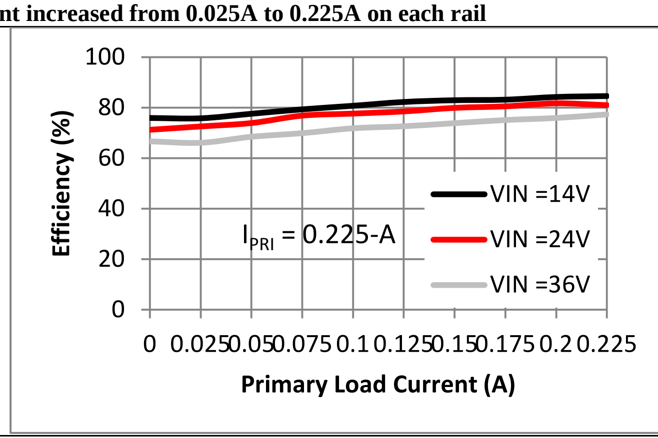


Figure 5. Efficiency with I_{SEC} set at 225mA load and I_{PRI} increasing from 0A to 225mA

Load Regulation Data

Dotted line plots (**- - - -**) show $\mathbf{V_{PRI}}$ and the solid line plots show $\mathbf{V_{SEC}}$ **(unless specified otherwise).**

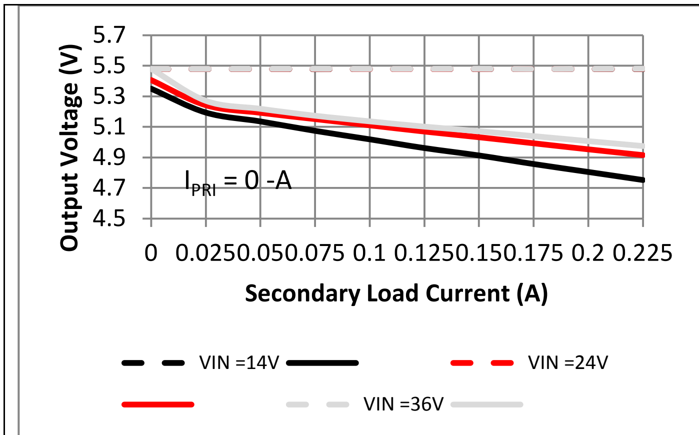


Figure 6. Load Regulation with I_{PRI} set at 0A and I_{SEC} increasing from 0A to 225mA

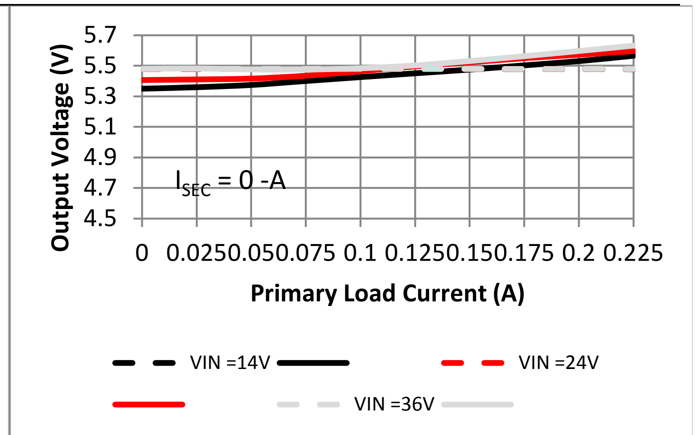


Figure 7. Load Regulation with I_{SEC} set at 0A and I_{PRI} increasing from 0A to 225mA

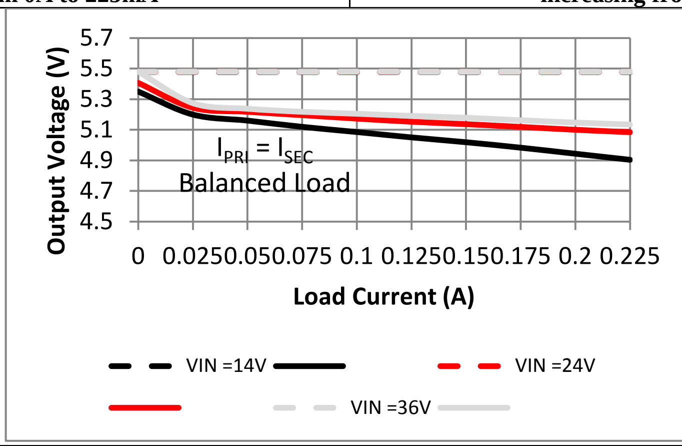


Figure 8. Load Regulation with I_{PRI} = I_{SEC} = Load Current increased from 0A to 0.225A on each rail

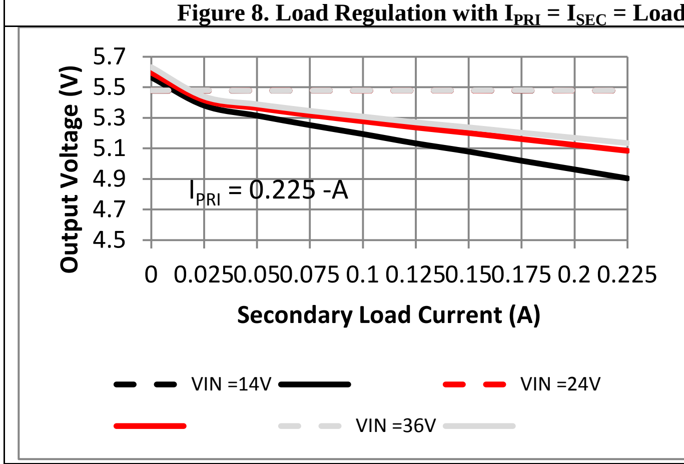


Figure 9. Load Regulation with I_{PRI} set at 225mA load and I_{SEC} increasing from 0A to 225mA

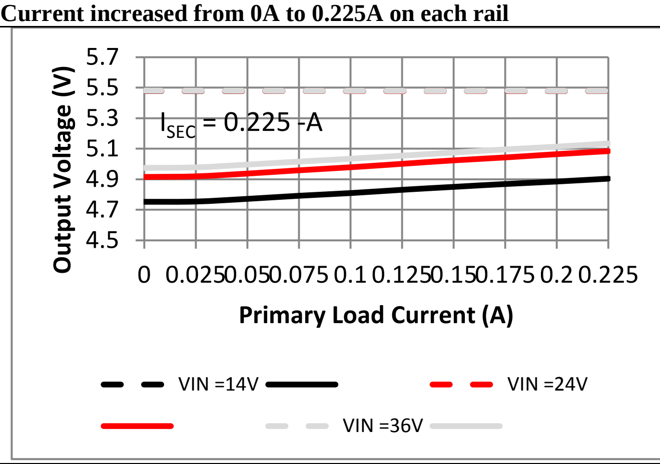


Figure 10. Load Regulation with I_{SEC} set at 225mA load and I_{PRI} increasing from 0A to 225mA

Line Regulation Data

Dotted line plots (**- - - -**) = **V_{PRI}** and the solid line plots = **V_{SEC} (unless specified).**

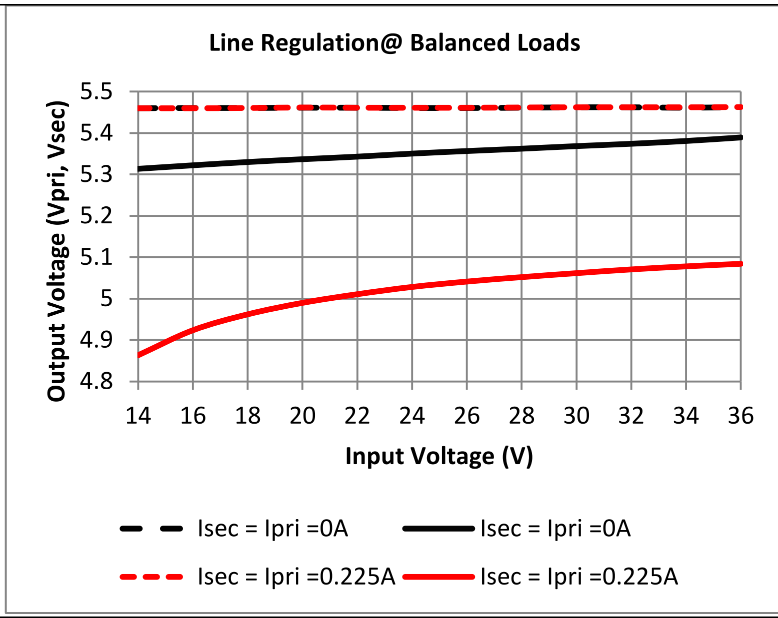


Figure 11. Line Regulation with I_{SEC} = I_{PRI} (Balanced Loads)

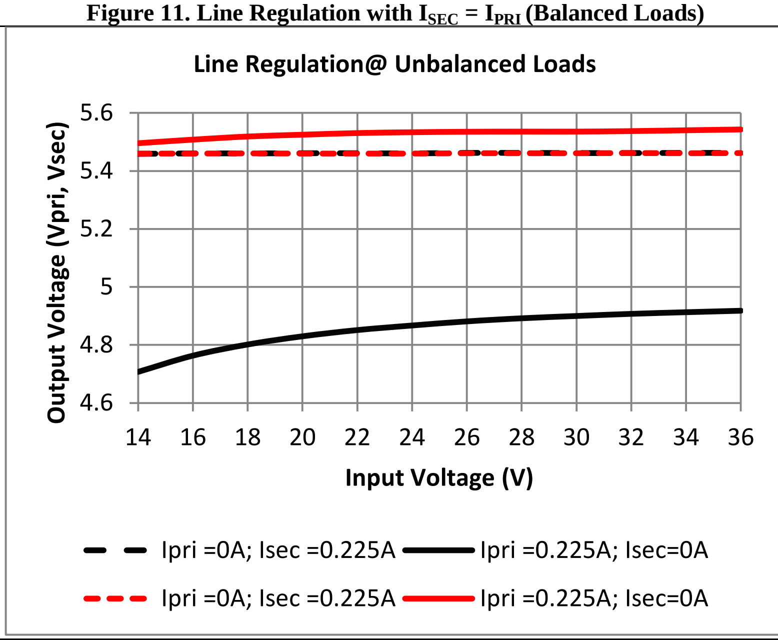


Figure 12. Line Regulation with $I_{SEC} \neq I_{PRI}$ (Unbalanced Loads; Unloaded one rail while fulling loading the other rail)

Start Up

Test condition: VIN = 24V, both outputs set at No load (0mA on Primary and Secondary).
C1 (Yellow) – VIN

C2 (Red) – I_{PRI} : Primary Coupled Inductor Winding Current

C3 (Blue) –V_{SEC} (5.45V)

C4 (Green) –V_{PRI} (5.48V)

Figure 13. Startup at No load

Test condition: VIN = 24V, both outputs set at Full load (225mA on Primary and Secondary).
C1 (Yellow) – VIN

C2 (Red) – I_{PRI} : Primary Coupled Inductor Winding Current

C3 (Blue) –V_{SEC} (5.1V)

C4 (Green) –V_{PRI} (5.48V)

Figure 14. Startup at Full load

Load Transients

V_{SEC} Load Step @ I_{PRI} =0-A

Test condition: VIN = 24V with I_{PRI} set to 0A**.**

CH1 (Yellow) - I_{SEC} = load step from 150mA to 300mA with slew rate set to 500mA/us

CH3 (Blue) - V_{SEC} (AC coupled); ΔV_{SEC} = 210mV peak to peak

CH4 (Green) - V_{PRI} (AC coupled); ΔV_{PRI} = 25mV peak to peak

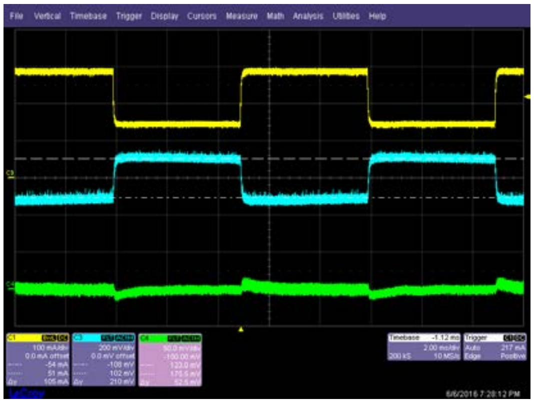


Figure 15. Secondary Side Load Transient at No load on Primary

V_{SEC} Load Step @ I_{PRI} =150-mA

Test condition: VIN = 24V with I_{PRI} set to 150mA**.**

CH1 (Yellow) - I_{SEC} = load step from 150mA to 300mA with slew rate set to 500mA/us

CH3 (Blue) - V_{SEC} (AC coupled); ΔV_{SEC} = 208mV peak to peak

CH4 (Green) - V_{PRI} (AC coupled); ΔV_{PRI} = <25mV peak to peak

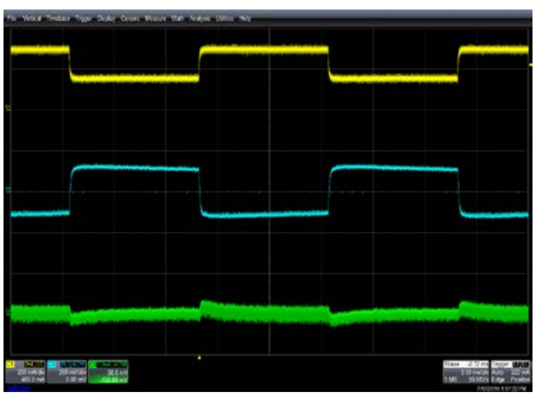


Figure 16. Secondary Side Load Transient at 150mA load on Primary

V_{PRI} Load Step @ I_{SEC} =0-A

Test condition: VIN = 24V with I_{SEC} set to 0A

CH1 (Yellow) - I_{PRI} = 100mA to 200mA with slew rate set to 500mA/us

CH3 (Blue) - V_{SEC} (AC coupled); ΔV_{SEC} = 110mV peak to peak

CH4 (Green) - V_{PRI} (AC coupled); ΔV_{PRI} = 10mV peak to peak

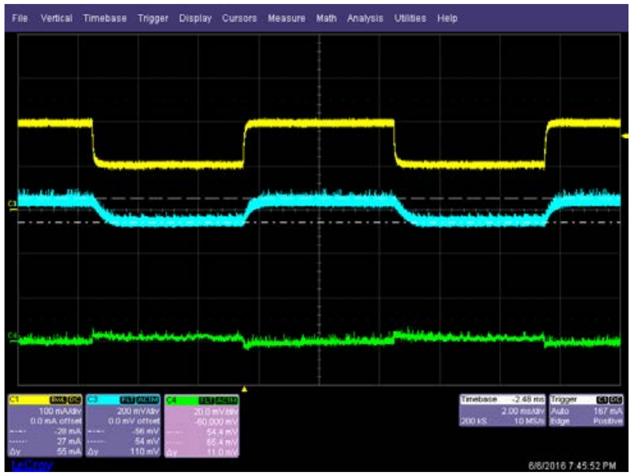


Figure 17. Primary Side Load Transient at no load on Secondary

V_{PRI} Load Step@ I_{SEC} =150-mA

Test condition: VIN = 24V with I_{SEC} set to 150mA

CH1 (Yellow) - I_{PRI} = 100mA to 200mA with slew rate set to 500mA/us

CH3 (Blue) - V_{SEC} (AC coupled); ΔV_{SEC} = 60mV peak to peak

CH4 (Green) - V_{PRI} (AC coupled); ΔV_{PRI} = <15mV peak to peak

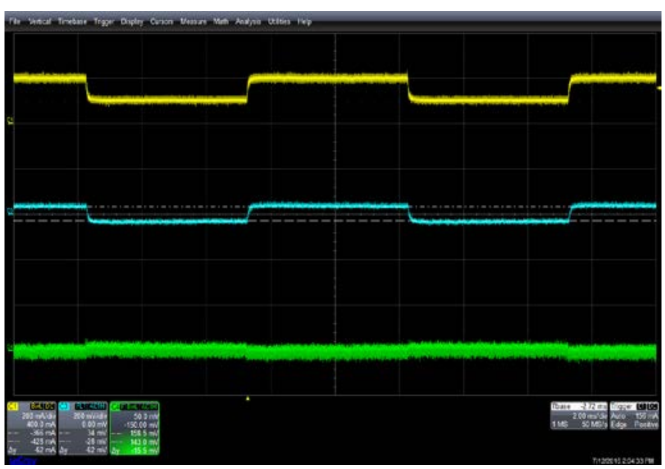


Figure 18. Primary Side Load Transient at 150mA load on Secondary

SW Node and Output Voltage Ripple Waveforms

Test condition: VIN = 36V, both outputs set to full load (225mA on Primary and on Secondary).

C1 (Yellow) - Switch node

C2 (Red) - I_{PRI} : Primary Coupled Inductor Winding Current

C3 (Blue) - V_{SEC} (DC coupled): ΔV_{SEC} < 100mV peak to peak

C4 (Green) - V_{PRI} (AC coupled): ΔV_{PRI} < 80mV peak to peak

Figure 19. Steady State at Full Load

Short Circuit Test

A short circuit on either output may result in failure to the LM5160. The saturation current rating of the coupled inductor used is lower than the typical current limit of the IC. Should a short circuit occur, this will result in saturation of the coupled inductor. For applications that require short circuit protection, it is strongly recommended that a coupled inductor with higher saturating currents above 2.5A, be used.